PATENT CLAIMS

1. A device for the generation of hydrogen, comprising

   a. a heated steam reformation stage (1) with a reformer catalyst for the conversion of gaseous or vaporizable hydrocarbons and water into hydrogen, carbon monoxide and further reformation products;

   b. at least one stage (2a, 2b) that is arranged downstream of the steam reformation stage (1) for the catalytic conversion of the mixture of hydrogen, carbon monoxide, and excess water steam (shift step) emanating from the steam reformation stage; and

   c. a fine purification stage (3) that is arranged downstream of the conversion stage(s) (2a, 2b) for the catalytic reduction of the residual carbon monoxide content of the conversion products,

   characterized in that the conversion stage(s) (2a, 2b) and the fine purification stage (3) are each embodied as hollow bodies with an annular chamber for housing the corresponding catalysts.

2. The device according to claim 1, characterized in that the steam reformation stage (1) is embodied as a hollow body, preferably as a hollow cylinder, with a shell chamber, preferably an annular chamber, for

housing the reformer catalyst, and that a heating device (4) is arranged in the shell chamber.

3. The device according to claims 1 or 2, characterized in that the heating device (4) is embodied as a burner.

4. The device according to one of the claims 1 to 3, characterized in that the annular chamber of the (first) conversion stage (2a) directly connects to the annular chamber of the steam reformation stage (1), and the annular chamber of the fine purification stage (3) directly connects to the annular chamber of the (last) conversion stage (2b) to form a complete annular chamber over all the stages (1, 2, 2a, 3).

5. The device according to one of the claims 1 to 4, characterized in that the cross sectional thickness of the complete annular chamber is approximately 2 to 20 % of the exterior diameter of the hollow body.

6. The device according to one of the claims 1 to 5, characterized in that the catalyst is arranged in at least one of the annular chambers in a honeycomb structure, preferably arranged on a flow channel limiting (corrugated) metal foil.

7. The device according to claim 6, characterized in that perforations are provided between the flow channels for improving the material exchange.

8. The device according to one of the claims 1 to 7, characterized in that at least one flow channel (5) is provided in the interior of the hollow body (bodies).

9. The device according to one of the claims 1 to 7, characterized in that the main direction of flow of hydrogen and of the reformer products within the hollow body is preferably essentially oriented parallel to its axis.

10. The device according to claim 9, characterized in that the flow channel (5) represents an annular chamber.

11. The device according to claims 9 or 10, characterized in that the flow channel (5) is embodied for feeding and preheating the hydrocarbons in the opposite direction of the flow of the gaseous products coming from the conversion stage(s) (2a, 2b) and the fine purification stage (3).

12. The device according to one of the claims 1 to 11, characterized that an indirect heat exchanger is provided at least between the conversion stage(s) (2a, 2b) and the steam reformation stage, and possibly also between the conversion stage (2b) and the fine purification stage (3), through which the water required for the steam reformation is guided in counter flow of the gaseous products coming from the conversion stage(s) (2a, 2b) and possibly also from the fine purification stage (3).

13. The device according to one of the claims 1 to 11, characterized in that the fine purification stage (3)

is embodied optionally as a selective oxidation stage (SelOx stage), or as a methanation stage.

14. The device according to claim 13, characterized in that the SelOx stage is equipped with an air supply (9) that is evenly arranged across the circumference of the annular chamber of the fine purification stage (3).

15. The device according to claim 14, characterized in that the air supply (9) is embodied as an annular manifold with distributed discharge nozzles.

16. The device, particularly according to claims 1 to 15, characterized by a flow guide enclosure (10) that envelopes the conversion stage(s) (2a, 2b) from the exterior, for a cooling medium for the cooling of the conversion stage(s) (2a, 2b), whereas the cooling medium preferably is water or hydrocarbons, which can be fed to the steam reformation stage (3) in the form of steam.

17. The device according to claim 16, characterized in that the flow guide enclosure (10) contains input (13) and output (14) connections for the cooling medium, and is optionally designed in the equal or counter flow of the through flow direction within the conversion stage(s) (2a, 2b).

18. The device according to claims 16 or 17, characterized in that the flow guide enclosure (10) is hydraulically connected on the discharge connection side to the reformation stage (1) on the educt input side.

19. The device according to one of the claims 16 to 18, characterized in that a control valve (15) is provided as an option at the input (13) and/or output (14) connections of the flow guide enclosure (10) for the mass adjustment of the flow of the cooling medium.

20. The device according to one of the claims 1 to 19, characterized in that (a) temperature sensor(s) (17) is (are) arranged at the downstream end of the annular chamber of the conversion stage(s) (2a, 2b), which is (are) connected to the control valve (15) for the mass adjustment of the flow of the cooling medium via an upstream control unit (16).

21. The device according to one of the claims 1 to 20, characterized in that an additional cooling medium channel (16) is arranged in the interior of the hollow cylindrically embodied conversion stage(s) (2a, 2b), through which preferably and optionally water and/or the hydrocarbons can flow.